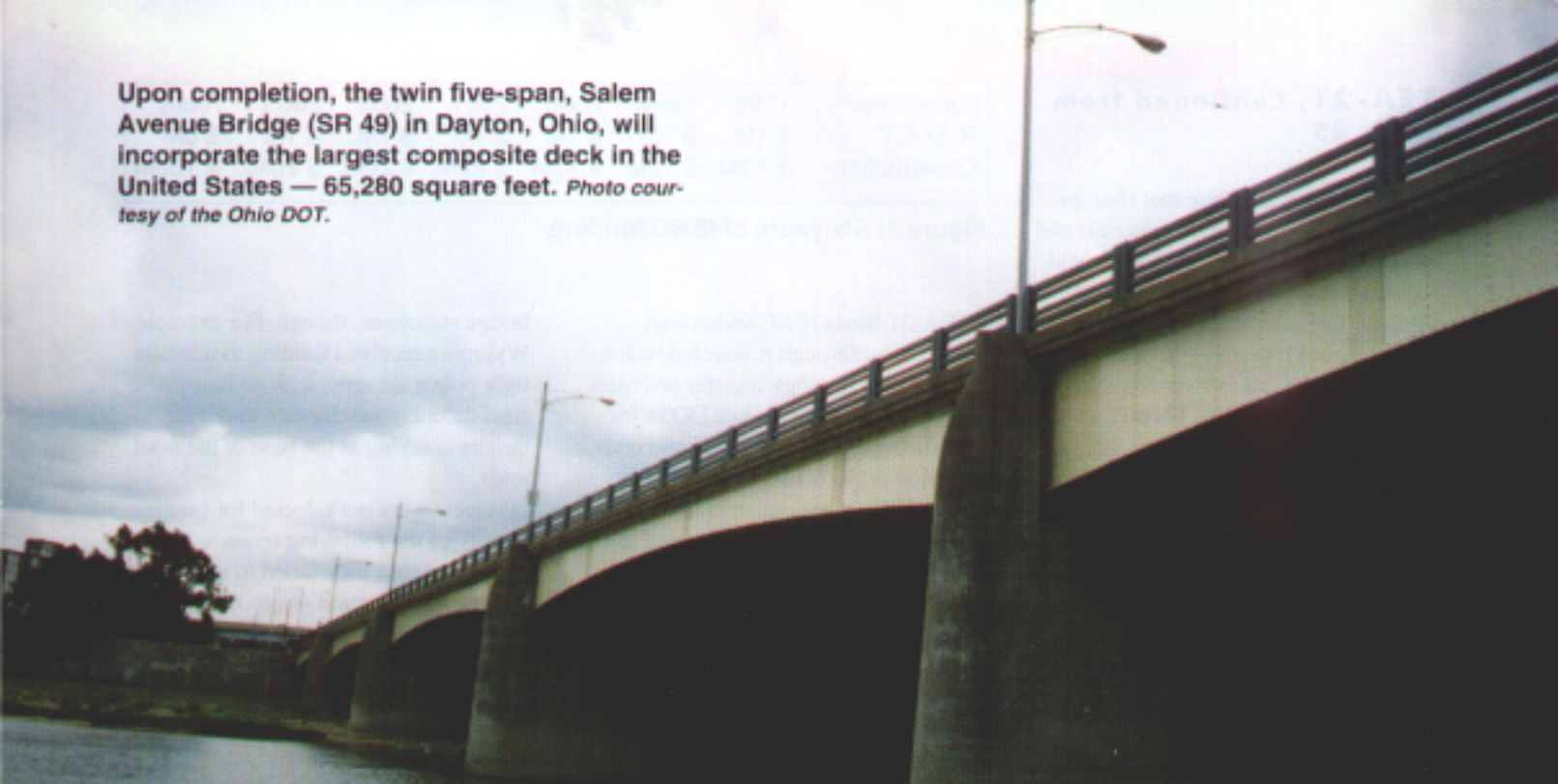


Upon completion, the twin five-span, Salem Avenue Bridge (SR 49) in Dayton, Ohio, will incorporate the largest composite deck in the United States — 65,280 square feet. Photo courtesy of the Ohio DOT.



## TEA-21 promotes innovative materials and technologies

*Two major initiatives to improve condition, durability and capacity of bridges*

By John M. Hooks, PE,

**"B**ridge" has long been a common metaphor for joining points separated — whether by distance or time. Bridges span physical separations and are critical elements of a highway system for crossing topographical features, as well as for separating opposing traffic patterns. We've also heard much about the symbolic bridge to the 21st century. When Congress passed the Transportation Efficiency Act for the 21st Century (TEA-21), however, it literally created a bridge for the 21st Century.

TEA-21 authorizes funds for two major initiatives intended to improve the condition, durability, and capacity of the nation's 585,000 bridges. First, TEA-21 continues the Highway Bridge Rehabilitation and Replacement Program (HBRRP), which, since 1979, has been instrumental in improving or replacing more than 52,000 bridges. TEA-21 authorizes \$20.4 billion to rehabilitate or

replace bridges judged to be eligible because of deteriorated condition or reduced capacity. Of this total sum each year, \$100 million is available at the discretion of the Secretary of Transportation for the repair and replacement of bridges.

Second, TEA-21's Technology Deployment Program [Sec. 5103]

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launches a new initiative that champions the use of innovative materials and technologies to repair, rehabilitate and replace bridges or to construct new bridges. The goal of the Technology Deployment Program — to accelerate the adoption of innovative technologies — is consistent with the FHWA's strategic goals to increase mobility and productivity on the nation's highways, while enhancing the safety of the nation's drivers. The program also promotes close partnerships with states, localities and industry in meeting its goal. The Innovative Bridge Research and Construction Program (IBRC) provides direction and funding to help reach these goals.

### TEA-21 reinforces FHWA strategic performance goals

TEA-21's emphasis on innovative materials and technologies advances strategic goals defined by the U.S. Department of Transportation (DOT) in its Strategic Plan for Fiscal Years 1997 to 2002. The Strategic Plan commits the Department — and the Federal Highway Administration (FHWA) — to improve the nation's mobility and productivity and enhance safety. The seven legislated goals of the IBRC program provide insight into its intent by advancing:

- New, cost-effective, innovative material highway bridge applications.
- Reduced maintenance and lifecycle costs of bridges, including the costs of new construction, replacement or rehabilitation of deficient bridges.
- Construction techniques to increase safety and reduce construction time and traffic congestion.
- Engineering design criteria for innovative products and materials for use in highway bridges and structures.
- Highway bridges and structures that will withstand natural disasters, including alternative processes for the seismic retrofit of bridges.
- New nondestructive bridge evaluation technologies and techniques.
- Cost-effective and innovative techniques to separate vehicle and pedestrian traffic from railroad traffic.

Fiscal Year	1998	1999	2000	2001	2002	2003	Totals
R, D & T	\$ 1M	\$ 1M	\$ 1M	\$ 1M	\$ 1M	\$ 1M	\$ 6M
Construction	\$ 10M	\$ 15M	\$ 17M	\$ 20M	\$ 20M	\$ 20M	\$ 102M

Figure 1: Six years of IBRC funding.

TEA-21 funds IBRC technology deployment through research development and technology transfer activities and through grants to state DOTs for specific repair, rehabilitation and construction projects (See Figure 1, this page.) IBRC was implemented very quickly after TEA-21 was passed in June 1998, and the first solicitation for candidate projects was published on July 29, 1998, with nominations due by September 1, 1998. Considering the very tight time frame, the response was overwhelming.

### FY 98-99 IBRC solicitation attracts 111 projects

Twenty-five states submitted proposals for 111 projects to be funded with FY 1998-1999 IBRC grants. The purpose of the solicitation was to encourage the states to identify projects they consider applications of innovative materials for structures. Selection criteria for this solicitation were mainly concerned that projects meet one or more program goals. No materials were restricted from consideration, but the evaluation panel looked primarily for those that increase durability, increase load carrying capacity or produce more durable bridges.

Of the 111 projects submitted, evaluators determined 60 were well-qualified for funding. Grants were made for the entire scope of the innovation process, including engineering, repair or construction, and post-construction monitoring and evaluation. Eighty percent of these projects were funded at 100 percent of these estimated costs. The range of projects included a \$3 million FRP composite bridge in California, and a \$7,000 grant for a high-performance concrete bridge in Iowa that incorporates an innovative material that reacts with portland cement concrete to increase mix density and lower permeability. Evaluators also funded two yet-to-be-selected high-performance concrete bridge projects in Virginia.

Not all projects funded were for

bridge structures, though. For example, Wyoming received funding to upgrade light pole mast arms with an innovative steel damping mechanism to reduce fatigue cracking at the base of the mast arms.

Projects were not selected for funding for any of the following reasons: primarily because they failed to demonstrate the application of innovative materials, met no program goal, or a project had no apparent application beyond this project. For example, several states submitted projects incorporating technology that evaluators felt was still in the research phase and not ready for widespread deployment. Other projects were not funded because they duplicated similar projects that were being funded in the same state. There were some submissions that were not well-qualified for funding in FY 1998-1999 because their letting dates were after FY 1999. These were deferred for possible FY 2000 funding subject to resubmittal by the state highway agency.

Projects submitted also encompassed a range of innovative materials, including high-performance concrete and high-performance steel, fiber-reinforced composites and alternative systems for protecting reinforcing bars.

### Building better bridges is the goal

An important component of IBRC is the involvement of state and industry partners in the design, construction and monitoring of those structures. Two bridge projects provide excellent examples of how cooperative partnerships can produce better, innovative bridges.

One well-recognized model of incorporating new materials and technologies in bridge construction is the Salem Avenue Bridge (Montgomery SR 49) in Dayton, Ohio. When completed, this twin five-span, 680-foot-long, 48-foot-wide bridge will incorporate the largest composite bridge



Switching to high-performance steel allowed the Tennessee DOT to build the Martins Creek Bridge for less than its estimated cost and monitoring will provide valuable information and data for future bridge projects. Photo courtesy of the Tennessee DOT.



deck in the United States — 65,280 square feet. In addition to the Ohio DOT, partners include FHWA, HITEC, The Composites Institute, Montgomery County Engineers, four universities, the U.S. Army Corps of Engineers and four manufacturers. For example, environmental testing and materials testing will be by the University of Maine. The University of Kentucky tested the deck panels, and the University of Cincinnati and the Ohio University were responsible for field monitoring. The Corps of Engineers is conducting 10 million cycles of fatigue testing on the bridge materials. Half of the materials will be tested at -22° F, the other half will be tested at 120° F. Fiber optics will provide long-term monitoring of the internal structure.

According to ODOT's Steve Morton, "TEA-21 has provided the financial support to incorporate innovative materials in projects that we might not otherwise be able to fund, and it helps industry pursue composites in an area or application that they might not consider. More important, the Salem Avenue Bridge project is an opportunity to compare high-performance materials to conventional materials in terms of lifecycle costs and durability. We anticipate that this is a good opportunity to test advanced materials so that we can identify specifications that can be used by the American

Association of State Highway & Transportation Officials (AASHTO) to develop performance and design specifications for bridge construction."

The Salem Avenue Bridge project was out for bid by at the end of March and construction should begin in late May or June.

The Martins Creek bridge in Tennessee also demonstrates the potential of TEA-21 and IBRC. The American Iron and Steel Institute had developed a high-performance, 70-ksi yield strength steel for the U.S. Navy and the FHWA that demonstrated better fatigue resistance and weathering and was lighter and less costly to fabricate. The Steel Institute was looking for a demonstration platform to test the steel. FHWA saw the potential to incorporate the material into bridge construction, but it needed to build a full-scale bridge to observe construction process and monitor performance.

Tennessee DOT had completed the design by load and resistance factor specifications on a bridge for Martins Creek based on 50,000 lb.-yield steel, but not high-performance 70,000-lb.-steel. TNDOT agreed to assume the cost of redesigning the bridge, and FHWA agreed to assume the cost for the difference between the original and the redesigned cost. According to TNDOT's Ed Wasserman, "As it turned out, we were able to build the

bridge for less than our original cost estimate, and we learned a great deal in the process. The intensive monitoring scheduled for the structure during and after fabrication will provide valuable information and data for future projects."

Work on the Martins Creek Bridge began before TEA-21, but, as the bridge demonstrates, the legislation's extra support can provide more opportunities for demonstration projects and new bridge configuration and monitoring high-performance materials.

The Salem Avenue and Martins Creek projects are but two examples of the opportunity that TEA-21, and IBRC, give states to use innovative materials and imaginative procedures to build efficient and cost-effective bridges—the spans to our nation's tomorrow.

To learn more about the IBRC program, including the solicitation and selection of projects for FY 2000 and beyond, visit <http://www.fhwa.dot.gov/bridge>, and click on IBRC. This web page will provide detailed information on projects under way, as well as related research, development, and technology transfer efforts to enhance the use of innovative materials.

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